

## **Saving Energy in Buildings through Local Architecture Principles**

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### **Abstract**

Today, fossil energy consumption and pollution resulting in climate change have turned into a big problem for human beings. Buildings as well as other things are being considered as an important factor in this regard. Geographical conditions and the climate are in direct relation with formation of a safe space for human beings. The analysis and recognition of the architectural features of each region can give us useful information in designs of our buildings. The local architecture is formed on the basis of local conditions in the long term. Generally, local architecture is being taken from natural properties in order to meet human beings' needs. By comparing today's buildings and buildings of modern architecture, we come to understanding that the objective of modern architecture is to provide comfort without taking environmental conditions into an account. In this study, the design is descriptive-analytical and data collection is done through field and documents.

**Keywords:** local architecture, buildings, energy

### **Introduction**

Regarding the energy consumption problems, the analysis and understanding of architecture features in each area can have a significant impact on the design and the optimization of the buildings as the local architecture is formed based on local conditions and climate. One of the foundations of architecture formation is the climate that makes the identity of local architecture based on different climate such as the desert areas, warm, wet, cold. Design of static techniques in order to save energy in the buildings and the implementation of the appropriate methods in the design of the buildings which coordinates with region's climate was paid attention from the past. Modern buildings with their inappropriate storage of energy need mechanical equipments for the well-being of humans. If the buildings are built based on each region's climate, the optimum use of that regions' possibilities will increase. The use of natural energy in buildings can play a very important role in saving up fuel consumption as well as increasing environmental protection. The survival of human beings highly depends on maintaining stability as well as safeguarding the biological world.

The local architecture consists of houses and buildings and the environmental conditions which depend on available resources, the building are made by the traditional methods and local architecture. The local architecture has tried to respond to community's basic needs, values and economic situation by paying attention to people's way of life and the culture of the Community (Oliver and Mires, 1998).

Not only the buildings were not centered themselves but also they step backward against environment. They were in human's scales and often the process of construction was more important than final product. There are many amazing architectural styles around the world which can familiarize us with forms, building materials, decorations, ideas for cooling and heating system and other familiar formation. Local buildings are made by local materials, methods and techniques of local architecture which are responsive to the weather conditions and reflect the culture of the community and people's lifestyle. All these have made different styles of local architecture that each is in response of its environmental needs (Oliver and Mires, 1998).

There are some examples of different types of local buildings according to the terms of their environment such as inclined roof to deal with snow and rain, circular houses to deal with tornado, a spherical ceiling, in order to circulate heat inside the house, the central yards which is a climate response to indoors and creating a safe space against sunlight and warm winds. The reality of local buildings is in change with cultural as well as environmental changes.

The design based on the principles of local climate and architecture is a way to keep the energy in the building. The buildings which are built based on the principles of local climate and architecture decrease the necessity of heating to minimum through using the natural energy available around the building.

### **Local architecture**

Local architecture is derived from peripheral property in order to make human beings meet their needs in the environment. "Spontaneous architecture" as Joseph Pagano invented, was the first architectural name for this phenomenon. In this term's analysis he writes: "By calling it spontaneous we do not mean that it was made randomly, but we mean its naturalness. This is a definite necessity which does not only encompasses the materialistic aspects (Oliver and Mires, 1998).

Hassan Fathi, a local architecture theorist, in his definition of this type of architecture mentions that it is particular to any nations which have taken its lines and custom forms based on their language and local customs. These forms of critical elements of local architecture is people's imagination with environmental demands (Fathi, 2003).

This type of architecture which comes from very simplest geometric forms focuses on free classification, view consideration and views around (Falamaki et al, 2005).

Local architecture is a collection of urban - architectural units which have come together with coordination in shape, in formation field, in applied field, in coloring field and harmony of full and empty surfaces as well as building materials and building systems. This coordination is based on the rules, customs and tastes which are products of environmental culture and environmental behavior. The architecture itself is a product of these changes based on local architectures which was a response to geographical needs coming to existence based on laws of each country (Falamaki et al, 2005). But, based on Falamaki's point of view, the local architecture is person's character is shown in it.

Local buildings come from the local materials, local methods, techniques and a responsive architecture to climatic conditions which reflects the culture of the community and people's lifestyle. This has made the different types of local architecture come to an existence based on each environmental specific needs (Oliver and Mires, 1998).

The architecture is a science which is formed in each area, it is a method of construction which through different materials, work forces and local traditions local people's needs are met. This kind of architecture which is the outcome of culture develops through time as well as cultural changes (Holm, 2006).

One of the suitable recognition of local architecture, is through experimental methods. Mansuor Falamaki has investigated three inseparable viewpoints for understanding experimental recognition: 1) constructing buildings regardless of direct and indirect impact of society, culture and economy, 2) paying attention to society's cultural environment and 3) architecture's attention to economic, administrative relation sets and production environment.

Cultural differences as well as climate diversity have had a great impact on physics of buildings. Local architecture is taken both from cultural factors and physical laws which climate, construction materials as well as culture are effective. Local architecture is under the influence of the following factors:

*Weather:* One the most important things that can specify architectural elements is climate and weather. The local knowledge to the regions climate, sun's movement, rain and snow in the region, winds, the coldest and hottest days of the year and many other issues have found a way in the region's architecture which people have gained this experience through trial and error. These methods can be easily seen in the construction of fireplaces, cellars, ponds and many other local architecture of Iran (Ghobadian, 2004).

*Culture:* The behavior of the natives and their lifestyle had affected architecture. The number of family members, the way of cooking and eating, social relationships and family gatherings, ceremonies and festivals have a great impact on the main design of the houses. That is why we can see different houses in the same region and climate (Oliver and Mires, 1998). This issue can be seen in Indonesia's outsides, king spot and kitchens as well as local architecture of Iran (Pirnia, 1998).

*Environment and the material :* The material used in the local architectures come from the local environment itself and does not do any harm to the environment as well. The application of these materials are clearly described in local architecture, local materials make a different and various forms in local architecture. For example, in areas with abundant trees the use of wood in the design of the houses is common or in areas with abundant stone supply, stones are used in building (Ghobadian, 2005)

Branda and Robert Mill mention six cases in this regard as follows:

- saving energy: buildings can be designed to provide the appropriate level of heat, ventilation
- Keeping with climatic conditions: any part of the world has a certain climate and weather which each creates different potential in using climate condition in order to provide a suitable, comfortable place for us to live in.
- To minimize the consumption of new resources: These two principle can be met in two ways, first by minimizing the use of nonrenewable resources and materials in new buildings and second reusing buildings or minimizing consumption of energy.
- Respect to the users: users must be involved in the process of changing and managing locations, they both affect are affect by where they live.
- Attention to the location: function of each building defines the location of that building. The land's conditions and ecology all affect buildings consciously or unconsciously.
- All these principles, together with strong and rational solutions have come to existence to build buildings and places in order to reduce the energy consumption.

### **The principles of local architecture**

According to Rudofsky (1964), local buildings have been made by locally available materials, local use, and renewable energy sources. The design of native separate buildings, both in urban and rural projects focused on the use of natural resources. Indigenous architectural principles are given below:

- Energy: the maximum use of local resources in heating, ventilation and light of local buildings according to local needs and local climate
- Direction of the tracks and urban roads, arrangement of buildings next to each other, building orientation, position on the floor plan, location of windows, doors, etc, due to considerations of climate and energy
- Using local materials from local sources (local buildings with a high percentage of material that cross-cultural context when it is parallel to the building.)

The growth of different models of buildings in response to available building material and different geographical condition of the areas mentioned by Pirniya is considered as principle that

according to the variety of each area has the same principles. In this principle, all of environmental concerns, human, cultural, etc. are considered. In summary, these principles are mentioned and defined below: the use of natural plants, natural lighting, natural ventilation, thermal properties, the structure and the architecture are included. Plan and vernacular architecture plan is in a way that has got the most harmony with the local climate, and creates impose minimum adaptation to the environment. Vernacular architecture in general can be traced to the three following characteristics:

- The materials, and the materials for making building and local knowledge are used easily.

Participation of local forces according to their tastes are used.

- Material and non-material costs will be reduced while maintaining the quality and benefits,

Also, more efficient energy conservation in buildings include building location, building form, underground , building style , openings , and the combination of internal spaces.

If you look at the local and traditional buildings ,we will realize that the use of renewable energy in buildings such as air, light and heat of the sun have been considered by the builders.

The building design compatible with 82% of the time in terms of thermal indoor climate naturally in the human comfort level will be adjusted. On the other hand, the constructors have built these buildings in a way that they have got the least negative effect on the living environment ,but against what it was typical as local architecture, in today's modern architecture, the excessive use of non-renewable energy or fossil fuel resources can be considered as the main difference with local architecture whose main factors is using inappropriate material and incorrect design of the building regardless of local conditions which need the use of heating system in winter and cooling system in summer.

Old architects were forced to rely on clean energy sources that are inexhaustible sources. Since the architecture in the past has been reached through different local projects which has handed down from one generation to the next generation and its place and continuum had been tested for 100 years using principles such as trial and error and it seems that in today's world where we are witnessing the development of modern architectural style, it is necessary to examine traditional and local approaches in the various regions. Sudden stop of relationship between modern and traditional architecture causes that most easy and efficient ways modern architecture replaced with old principles and consequently most environmental principles which are based on local designs may be sunk into oblivion. The building design compatible with 82% of the time of the year thermal indoor climate naturally and to the relaxation of humans will be modified. As Iran is a country with different climatic areas, reducing the energy requirements of a building should be designed according to the climate of that region. In all areas of the climate of the buildings were built according to the principles of ecological design to at least reduce the need for mechanical heating and cooling.

Information needed to achieve the above objectives can be five divided into five parts as characteristics of solar radiation, evaluation of temperature , characteristics rainfall and humidity, assessment of wind conditions, and insulation characteristics.

Buildings should be designed to minimize the energy for brightness and service spaces (for example, heat, water or building heating, ventilation, air conditioning and generate electricity for lighting). To meet all the rest of the needs, the solutions should be chosen to make a general balance in energy use and using the latest vocational skill through using different shapes of compatible energy with the environment should be considered.

The use of materials, shapes, construction, technology, construction, transportation, manufacturing, installation and assembly of structural components, the content, the amount of energy and life cycle (lifetime) materials need to be taken into consideration. Also, recyclable raw materials that are enough with accurate values are available and include various forms of building structures which have the least amount of primary energy consumption should be the priority. In addition, recycling building material should be guaranteed to be reused or they can be disposed possibly.

Strong structures and the skin of a building should be tough and high durable, which can guarantee the efficiency and the effectiveness of materials, energy consumption and minimizing the cost of production. Accordingly, an optimal relationship between the energy produced or used during its life must be achieved. Further, structural elements and components of the buildings that use solar energy actively or passively, those elements that are easily able to use to solve problems of design and dimension should be used for the future expansion and their use should be given priority. Finally, new systems and products in the field of production of energy and building technology must have this feature to get easily integrated with building components and composition and must be easily interchangeable and renewable.

The buildings can be regarded as perfect systems of energy based on their energy balance that gain diverse obtainable environmental energy and satisfy diverse and different needs in this connection. The buildings should be regarded as the stable systems that are capable of using various features in the long run. The following issues should also be considered:

- Plan and school performance should be determined in a way to calculate temperature changes and temperature zones.
- Drawing a plan, performance of the building and the selection of materials should be based on a solution and a concept which are flexible and reliable so that the next changes in their use could cost the least for energy and materials.
- Building shell permeability to light, heat and air, and the transparency of the building shell must be controllable and reversible, so that it can react to changes in local weather conditions (e.g. amount of solar energy, protect radiation, light, shading, protection against temporary warming and natural ventilation applicable).

The possibility that the welfare needs of residents should be directly met mainly through building design based on the common criteria must exist. The remaining required energy for heating, cooling, electricity, ventilation and lighting should be obtained through active systems which are economically provided by accessible energies.

Technical resources and energy which are in a building, must be proportional to the performance of the building. Studies indicate that the needs for different groups using the controls should be revised again and altered in anywhere which is needed. Buildings with specific applications, such as houses, museums, libraries, hospitals, etc., should be considered separately, because there is specific climatic conditions for each of them.

### **Conclusion**

The main difference between modern architecture and local architecture is the overuse of nonrenewable energy or in another word is a fossil fuel resource. In traditional and native buildings, the use of renewable energies such as air, light and heat of the sun has been regarded by the constructors.

Since Iran is a country with different climate areas, to reduce the required energy of building needs and maintaining the energy in the building, the design should be in accordance with the climate in that area. In the case of designing buildings, harmonious with the climate, in 82% of

the time of a year, thermal heat in the interior spaces will be normally moderated with human beings' comfort; Generally, the building should be designed based on energy balance, so that a building is considered as a complete system getting all kinds of energy from the environment and meeting different and various needs, and these buildings will have the least negative impact on the environment.

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